REMARKS

Claims 1-20 are all the claims presently pending in the application. Claims 6-20 are added. Claims 1, 5, and 6 are independent.

These amendments are made only to more particularly point out the invention for the Examiner and not for narrowing the scope of the claims or for any reason related to a statutory requirement for patentability.

Applicant also notes that, notwithstanding any claim amendments herein or later during prosecution, Applicant's intent is to encompass equivalents of all claim elements.

Claims 1-5 stand rejected under 35 U.S.C. § 103(a) as being obvious over the Hochstein reference (U.S. Patent No.5,783,909) in view of the Oda et al. reference (U.S. Patent No.5,068,570).

This rejection is respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

A first exemplary embodiment of the claimed invention, as defined by claim 1, is directed to a light emitting diode driving circuit that includes a control pulse signal generator for generating a control pulse signal having a variable duty factor, a smoothing circuit for smoothing the control pulse signal to generate a control voltage, a driving circuit for generating a driving voltage according to the control voltage and supplying a forward current to the light emitting diode, and a switching circuit for interrupting the forward current of the light emitting diode in response to the control pulse signal.

A second exemplary embodiment of the claimed invention, as defined by claim 5, is directed to a light emitting diode driving circuit that includes a control pulse signal generator

for generating a control pulse signal having a variable duty factor, a smoothing circuit for smoothing the control pulse signal to generate a control voltage, a driving circuit for generating a driving voltage according to the control voltage and supplying a forward current to the light emitting diode, a minimum control voltage generating circuit for generating a predetermined minimum control voltage, and a control voltage switching circuit for setting the minimum control voltage to the control voltage of the driving circuit in place of the control voltage when the control voltage drops to a predetermined value or lower. The control pulse signal generator includes a light adjustment pulse signal generating circuit for generating a light adjustment pulse signal of a duty factor according to a light adjustment amount, and a control pulse adjusting circuit for adjusting change characteristics of the duty factor of the light adjustment pulse signal and generating the control pulse signal.

A third exemplary embodiment of the claimed invention is directed to a light emitting diode driving circuit that includes a luminance controller that approximates the luminance change characteristics of a light emitting diode with the luminance change characteristics of a lamp.

Conventional light sources use lamps as light sources to illuminate, for example, a console panel of a vehicle. However, some of these lamps have required a large current and, as a result, a large transistor is required to control the supply of that current. Therefore, it has been difficult to reduce the size of a control circuit.

Further, there have been problems of short lamp life due to filament breakage.

Therefore, some conventional light sources have turned to light emitting diodes in place of lamps. However, since the illuminance controllers for these devices were designed based upon luminance change characteristics of a lamp, there have been many problems. For

instance, since the illuminance characteristics of lamps do not coincide with illuminance characteristics of light emitting diodes, it has been very difficult to accurately control the illuminance of the light emitting diode. As an example, the illuminance of the light emitting diode may decrease to slowly or too fast in response to an illumination control input.

The present invention overcomes these problems by providing a luminance controller that approximates the luminance change characteristics of a light emitting diode with the luminance change characteristics of a lamp.

II. THE PRIOR ART REJECTION

The Examiner alleges that the Oda et al. reference would have been combined with the Hochstein reference to form the claimed invention. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, the references are directed to completely different matters and problems.

Specifically, the Hochstein reference is directed to providing a luminous intensity controller for a light emitting diode which maintains the luminous intensity of the light emitting diode at a predetermined level (col. 2, lines 6-28; col. 3, lines 23-30; and col. 7, lines 7-13).

In stark contrast, the Oda et al. reference is specifically directed to a control circuit for a lamp, such as a metallic halide lamp or like discharge lamps (col. 1, lines 6-10). Further, the Oda et al. reference is more particularly directed to a lamp control circuit that can

automatically disconnect the lamp from the power supply in the event of an abnormal circuit condition such as caused by lamp failure or an excessive supply voltage (col. 1, lines 23-64). More specifically, the Oda et al. reference is concerned with providing protection against over-voltage and over-current in a lamp control circuit (col. 1, lines 60-64).

Therefore, contrary to the Examiner's allegations, one of ordinary skill in the art who was concerned with the problem of providing a luminous intensity controller for a light emitting diode which maintains the luminous intensity of the light emitting diode at a predetermined level as the Hochstein reference is directed to solving, would not have been motivated to refer to the Oda et al. reference which is directed to the completely different and unrelated problem of providing protection against over-voltage and over-current in a lamp control circuit. Thus, the references would not have been combined, absent hindsight.

Ok for claims NOT claim 1

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, the Examiner does not even support the combination by identifying a reason for combining the references.

The Examiner alleges that it would have been obvious to modify the light emitting diode luminous maintaining controller disclosed by the Hochstein reference with a smoothing circuit based upon the disclosure of the Oda et al. reference "to design a circuit that is protected against overvoltage and overcurrent."

Firstly, contrary to the Examiner's allegation, as described above, light emitting diodes have replaced lamps in light sources because the light emitting diodes do not require high voltages or high currents to operate. Therefore, there is no reason to protect against over-voltage and over-current in the light emitting diode luminous maintaining controller disclosed by the Hochstein reference simply because there is no threat from the voltages and

currents in the controller disclosed by the Hochstein reference. Thus, the Examiner's alleged motivation is completely inapplicable to the light emitting diode luminous maintaining controller disclosed by the Hochstein reference.

Secondly, the Oda et al. reference explains that overload protection has conventionally been unnecessary in light sources that use incandescent lamps because the worst possible outcome of these troubles has been the breakage of the lamp filaments (col. 1, lines 23-32). The Oda et al. reference then explains that metallic halide lamps have become popular and that these metallic halide lamps require high starting voltages that can cause "serious consequences without overvoltage protection." (col. 1, lines 33-41). The Oda et al. reference further explains that the lighting circuits for these metallic halide lamps have had difficulty with D.C. voltage booster circuits that are "prone to develop overvoltage or overcurrent" and that "[t]he lighting circuit and the lamps must also be protected against such overvoltage and overcurrent." However, the light emitting diode luminous maintaining controller disclosed by the Hochstein reference is not used for a metallic halide lamp. Therefore, since the only motivation disclosed by the Oda et al. reference for providing an over-voltage and over-current protection circuit is due to the use of a metallic halide lamp, the Examiner's alleged motivation is completely irrelevant and inapplicable to the light emitting diode luminous maintaining controller disclosed by the Hochstein reference.

Thirdly, the Examiner's alleged motivation has absolutely nothing to do with the use of a rectifier and smoother circuit that is disclosed by the Oda et al. reference. Rather, the Oda et al. reference discloses that a rectifier diode 41 and a electrolytic capacitor 12 form a part of an igniter starter 11 (col. 6, lines 22- 26). The Oda et al. reference explains that the igniter starter 11 is connected to a current limiter and lamp igniter circuit 8 to receive a signal

that represents the lamp current and that acts on the igniter section of the circuit 8 for controlling starting pulses and to deliver a timing signal to a lamp control circuit 12 (col. 3, lines 33-40).

More specifically, the igniter starter 11 senses when a current does not immediately flow upon closure of a lamp switch 22, to cause the contact of the relay 49 to engage the fixed contact NO to interconnect lines 33 and 34 and cause the capacitor 37 of the igniter circuit 8 to be charged and to apply a starting pulse to the lamp 10 (col. 7, line 54 - col. 8, line 7). After the lamp 10 begins to glow, the lamp current causes the transformer 40 to apply a voltage to the rectifier and smoother circuit means 41 and 42 and hence to cause conduction through the transistor 43 which, in turn, causes the relay 49 to de-energize and terminate application of the starting pulse (col. 8, lines 30-46).

Therefore, contrary to the Examiner's allegation the rectifier and smoother circuit means 41 and 42 have absolutely nothing to do with over-current or over-voltage protection. Rather, as clearly described and explained by the Oda et al. reference, the rectifier and smoother circuit means 41 and 42 form a portion of an igniter starter 11 that serves to control the application of a starting pulse.

Indeed, the light emitting diode luminous maintaining controller disclosed by the Hochstein reference does not even require a starting pulse, because the light emitting diode luminous maintaining controller disclosed by the Hochstein reference is only used for a light emitting diode and the starting pulse is only required for the metallic halide lamp disclosed by the Oda et al. reference.

Moreover, even assuming arguendo that one of ordinary skill in the art would have been motivated to combine these references, the combination would not teach or suggest each

and every element of the claimed invention.

None of the applied references teaches or suggests: 1) a control pulse signal generator; 2) a smoothing circuit that smooths the control pulse signal; 3) a switching circuit that interrupts the forward current in response to the control pulse signal; and 4) a smoothing circuit for smoothing a control pulse signal. As explained above, these features are important for approximating the luminance change characteristics of a light emitting diode with the luminance change characteristics of a lamp.

Rather, contrary to the Examiner's allegation, the Hochstein reference discloses a light emitting diode luminous maintaining controller that includes an ambient light sensor 22 or a temperature sensor 24 that provides a feedback control signal on lead 26 to a switched mode power supply 16. The Hochstein reference merely discloses that these sensors 22 and 24 sense "a condition proportional to the luminous intensity of the LEDs and for sending a signal to the power supply 16." The Hochstein reference does not teach or suggest that the control signal sent to the power supply 16 by the sensors 22 and 24 are pulse signals. Therefore, the Hochstein reference does not teach or suggest a control pulse signal.

The Examiner should not be confused between what is a control signal and the current that is being applied to the lamp. While the Hochstein reference appears to disclose that the power supply 16 may be a pulse width modulated power supply, that power supply includes a switching device that is responsive to the luminous intensity signal (from one of the sensors 22 and 24) "for adjusting the electrical energy supplied by the pulses per unit time to adjust the average current passing through the LED 12." Therefore, only the current being applied to the LEDs 12 are pulsed and the Hochstein reference does not teach or suggest any control signal that is pulsed.

Thus, as explained above, while the Hochstein reference disclose that the power supply 16 may pulse the current being supplied to the LEDs 12, contrary to the Examiner's allegation, the power supply 16 does not include a switching circuit that interrupts the forward current in response to a control pulse signal.

The Examiner agrees that the Hochstein reference does not teach or suggest a smoothing circuit.

The Oda et al. reference does not remedy the deficiencies of the Hochstein reference.

As explained above, rectifier and smoother circuit means 41 and 42 disclosed by the Oda et al. reference forms a part of an igniter starter 11. The rectifier and smoother circuit means 41 and 42 rectify and smooth a voltage supplied from a transformer 40 to control conduction through the transistor 43 which, in turn, controls the relay 49 to control application of a starting pulse.

Therefore, contrary to the Examiner's allegations, the Oda et al. reference does not teach or suggest a smoothing circuit that smooths a control pulse signal. Indeed, the voltage supplied from the transformer 40 is not a pulsed signal, let alone a control pulse signal.

Lastly, regarding claims 6-20, none of the applied references teach or suggest anything that is even remotely related to a luminance controller that approximates the luminance change characteristics of a light emitting diode with the luminance change characteristics of a lamp.

Therefore, the Examiner is respectfully requested to withdraw the rejection of claims 1-5.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully submits that claims 1-20, all the claims presently pending in the Application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the Application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: 12/23/03

James E. Howard
Registration No. 39,715

McGinn & Gibb, PLLC
8321 Old Courthouse Rd., Suite 200
Vienna, Virginia 22182
(703) 761-4100
Customer No. 21254